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PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 12 September 2000 (12.09.00)	
International application No. PCT/GB00/00161	Applicant's or agent's file reference PAT 99401PCT
International filing date (day/month/year) 14 January 2000 (14.01.00)	Priority date (day/month/year) 15 January 1999 (15.01.99)
Applicant LINDLAR, Heribert et al	

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

07 August 2000 (07.08.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer Pascal Piriou</p> <p>Telephone No.: (41-22) 338.83.38</p>
--	---

PCT REQUEST

PAT 99401PCT

Original (for SUBMISSION) - printed on 14.01.2000 11:58:36 AM

0	For receiving Office use only	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.90 (updated 15.12.1999)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	United Kingdom Patent Office (RO/GB)
0-7	Applicant's or agent's file reference	PAT 99401PCT
I	Title of invention	INTERFACE
II	Applicant	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	NOKIA MOBILE PHONES LIMITED
II-5	Address:	KEILALAHDENTIE 4 FIN-02150 ESPOO Finland
II-6	State of nationality	FI
II-7	State of residence	FI
II-8	Telephone No.	+358 24 3061
II-9	Facsimile No.	+358 24 30 64544
III-1	Applicant and/or inventor	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	LINDLAR, Heribert
III-1-5	Address:	Biermannsweg 24 D-44799 BOCHUM Germany
III-1-6	State of nationality	DE
III-1-7	State of residence	DE

PCT REQUEST

PAT 99401PCT

Original (for SUBMISSION) - printed on 14.01.2000 11:58:36 AM

III-2	Applicant and/or inventor	
III-2-1	This person is:	applicant and inventor
III-2-2	Applicant for	US only
III-2-4	Name (LAST, First)	SCHETELIG, Markus
III-2-5	Address:	GIRADET STR. 33 D-45131 ESSEN Germany
III-2-6	State of nationality	DE
III-2-7	State of residence	DE
III-3	Applicant and/or inventor	
III-3-1	This person is:	applicant and inventor
III-3-2	Applicant for	US only
III-3-4	Name (LAST, First)	BURGESS, Paul
III-3-5	Address:	ALSEN STR. 12 D-44789 BOCHUM Germany
III-3-6	State of nationality	GB
III-3-7	State of residence	DE
III-4	Applicant and/or inventor	
III-4-1	This person is:	applicant and inventor
III-4-2	Applicant for	US only
III-4-4	Name (LAST, First)	JOERESSEN, Olaf
III-4-5	Address:	GEIBEL STR. 30 D-40235 DUSSELDORF Germany
III-4-6	State of nationality	DE
III-4-7	State of residence	DE
IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name (LAST, First)	HIGGIN, Paul
IV-1-2	Address:	NOKIA IPR DEPARTMENT NOKIA HOUSE SUMMIT AVENUE SOUTHWOOD FARNBOROUGH, Hampshire GU14 0NG United Kingdom
IV-1-3	Telephone No.	+44 1252 865 000
IV-1-4	Facsimile No.	+44 1252 865 080
IV-1-5	e-mail	paul.higgin@nokia.com
IV-2	Additional agent(s)	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	HAWS, Helen; JEFFERY, Kendra; HIBBERT, Juliet; FRAIN, Timothy; MUIR, Henry

PCT REQUEST

PAT 99401PCT

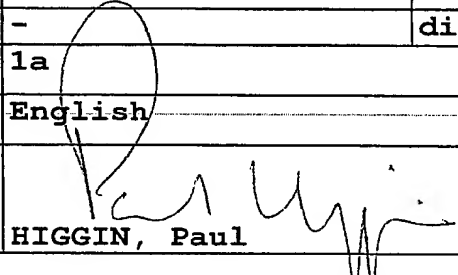
Original (for SUBMISSION) - printed on 14.01.2000 11:58:36 AM

V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	<p>AP: GH GM KE LS MW SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT</p> <p>EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT</p> <p>EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT</p> <p>OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT</p>
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	<p>AE AL AM AT AU AZ BA BB BG BR BY CA CH&LI CN CR CU CZ DE DK DM EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW</p>
V-5	Precautionary Designation Statement In addition to the designations made under Items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	Exclusion(s) from precautionary designations	NONE
VI-1	Priority claim of earlier national application	
VI-1-1	Filing date	15 January 1999 (15.01.1999)
VI-1-2	Number	9900829.4
VI-1-3	Country	GB
VI-2	Priority claim of earlier national application	
VI-2-1	Filing date	03 December 1999 (03.12.1999)
VI-2-2	Number	9928574.4
VI-2-3	Country	GB

PCT REQUEST

PAT 99401PCT

Original (for SUBMISSION) - printed on 14.01.2000 11:58:36 AM

VI-3	Priority claim of earlier national application		
VI-3-1	Filing date	07 December 1999 (07.12.1999)	
VI-3-2	Number	9928856.5	
VI-3-3	Country	GB	
VI-4	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1, VI-2, VI-3	
VII-1	International Searching Authority Chosen	European Patent Office (EPO) (ISA/EP)	
VIII	Check list	number of sheets	electronic file(s) attached
VIII-1	Request	4	-
VIII-2	Description	15	-
VIII-3	Claims	5	-
VIII-4	Abstract	1	p99401pctabstract.txt
VIII-5	Drawings	7	-
VIII-7	TOTAL	32	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-18	Figure of the drawings which should accompany the abstract	1a	
VIII-19	Language of filing of the international application	English	
IX-1	Signature of applicant or agent		
IX-1-1	Name (LAST, First)	HIGGIN, Paul	

FOR RECEIVING OFFICE USE ONLY

10-1	Date of actual receipt of the purported international application	
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	
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PCT (ANNEX - FEE CALCULATION SHEET)

PAT 99401PCT

Original (for **SUBMISSION**) - printed on 14.01.2000 11:58:36 AM

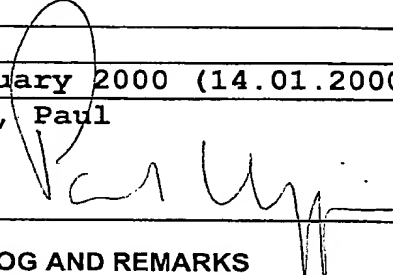
(This sheet is not part of and does not count as a sheet of the international application)

0	For receiving Office use only		
0-1	International Application No.		
0-2	Date stamp of the receiving Office		
0-4	Form - PCT/RO/101 (Annex)		
0-4-1	PCT Fee Calculation Sheet Prepared using	PCT-EASY Version 2.90 (updated 15.12.1999)	
0-9	Applicant's or agent's file reference	PAT 99401PCT	
2	Applicant	NOKIA MOBILE PHONES LIMITED, et al.	
12	Calculation of prescribed fees	fee amount/multiplier	total amounts (GBP)
12-1	Transmittal fee T	⇒	55
12-2	Search fee S	⇒	638
12-3	International fee Basic fee (first 30 sheets) b1	264	
12-4	Remaining sheets	2	
12-5	Additional amount (X)	6	
12-6	Total additional amount b2	12	
12-7	b1 + b2 = B	276	
12-8	Designation fees Number of designations contained in international application	83	
12-9	Number of designation fees payable (maximum 8)	8	
12-10	Amount of designation fee (X)	56	
12-11	Total designation fees D	448	
12-12	PCT-EASY fee reduction R	-81	
12-13	Total International fee (B+D-R) I	⇒	643
12-14	Fee for priority document Number of priority documents requested	3	
12-15	Fee per document (X)	22	
12-16	Total priority document fee P	⇒	66
12-17	TOTAL FEES PAYABLE (T+S+I+P)	⇒	1,402
12-19	Mode of payment	authorization to charge deposit account	
12-20	Deposit account instructions The receiving Office:	United Kingdom Patent Office (RO/GB)	
12-20-1	is hereby authorized to charge the total fees indicated above to my deposit account	✓	
12-20-2	is hereby authorized to charge any deficiency or credit any over-payment in the total fees indicated above to my deposit account	✓	
12-20-3	is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account	✓	

PCT (ANNEX - FEE CALCULATION SHEET)

PAT 99401PCT

Original (for SUBMISSION) - printed on 14.01.2000 11:58:36 AM

12-21	Deposit account No.	D02716
12-22	Date	14 January 2000 (14.01.2000)
12-23	Name and signature	HIGGIN, Paul 

VALIDATION LOG AND REMARKS

13-2-6	Validation messages Contents	Yellow! The power of attorney or a copy of the general power of attorney will need to be furnished unless all applicants sign the request form.
13-2-8	Validation messages Payment	Green? Please ensure that you have a valid deposit account with the receiving Office selected.

PATENT COOPERATION TREATY

Comp Record

File Record

☐ ☐ Diary

1 2 APR 2001

☐ **PCT** Renewal Record☐ Citations☐ Letters☐ OF TRANSMITTAL OF ☐ CCNOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY

EXAMINATION REPORT

(PCT Rule 71.1)

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

HIGGIN, PAUL **PTO/PCT Rec'd 13 JUL 2001**
 NOKIA IPR DEPARTMENT
 Summit Avenue, Farnborough
 Hampshire GU14 0NG
 GRANDE BRETAGNE

Date of mailing
(day/month/year)

10.04.2001

Applicant's or agent's file reference
PAT 99401PCT

IMPORTANT NOTIFICATION

International application No.
PCT/GB00/00161International filing date (day/month/year)
14/01/2000Priority date (day/month/year)
15/01/1999Applicant
NOKIA MOBILE PHONES LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/

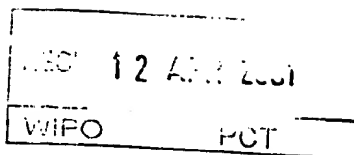
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 Fax: +49 89 2399 - 4465

Authorized officer

Barrio Baranano, A

Tel. +49 89 2399-8621





INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PAT 99401PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/00161	International filing date (day/month/year) 14/01/2000	Priority date (day/month/year) 15/01/1999
International Patent Classification (IPC) or national classification and IPC H04L12/56		
Applicant NOKIA MOBILE PHONES LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 07/08/2000	Date of completion of this report 10.04.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Köppl, M Telephone No. +49 89 2399 8433



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00161

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-15 as originally filed

Claims, No.:

1-27 as originally filed

Drawings, sheets:

1/7-3/7,5/7-7/7 as originally filed

4/7 as received on 19/01/2001 with letter of 10/01/2001

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/00161

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-27
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-24
	No:	Claims	25-27
Industrial applicability (IA)	Yes:	Claims	1-27
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00161

Re Item V

Reasoned statement under Article 35 (2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1: US-A-5 636 140 (LEE DENNIS ET AL) 3 June 1997 (1997-06-03)

D2: US-A-5 365 546 (FREDE WILLIAM W ET AL) 15 November 1994
(1994-11-15)

2 The subject-matter of claims 1 and 21, as far as they are clear (see Re Item VIII below), concerns an interface circuitry for an RF transceiver circuitry.

Document D1 discloses such interface circuits (see figures 3 and 4, and the associated description on column 4. line 35 to column 5, line 11) where there is provided a separate set of lines (for transferring data signals as well as control signals) in the transmit path and the receive path.

Document D2 discloses a similar such interface (see figures 5 to 8).

The subject-matter of claim 1 is based on the problem of reducing the number of connectors needed for the interface.

The problem is solved by allowing a first and a second connector to be operated in two modes in which one connector is transmitting or receiving data, respectively, and the other connector is performing mode dependent control functions.

The solution is neither known from the available prior art nor is it suggested thereby. The subject-matter of claim 1 therefore appears to be novel and to involve an inventive step.

Claim 21 appears to relate effectively to the same subject-matter as claim 1 and to differ therefrom only with regard to the definition of the subject-matter for which protection is sought or in respect of the terminology used for the features of that

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00161

subject-matter (see Re Item VIII below). Therefore, the subject-matter of claim 21 also appears to be novel and to involve an inventive step.

Claims 2 to 20 and 22 to 24 relate to embodiments of the subject-matter claimed in claims 1 and 21, respectively. Therefore, the subject-matter of claims 2 to 20 and 22 to 24 also appears to be novel and to involve a inventive step.

- 3 The subject-matter of claims 25 to 27, as far as they are clear (see Re Item VIII below), appears not to involve an inventive step in the sense of Article 33 (3) PCT. Reference is made to figures 3 and 4 of document D1 and column 14, lines 37 to 41 of document D2 suggesting that the subject-matter trying to be defined by claims 25 to 27 is obvious.
- 4 The industrial applicability of the subject-matter of all claims is beyond doubt.

Re Item VII

Certain defects in the international application

- 5 Independent claims 1, 21, and 25 to 27 are not in the two-part form in accordance with Rule 6.3 (b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1 or D2) being placed in a preamble (Rule 6.3 (b) (i) PCT) and with the remaining features being included in a characterising part (Rule 6.3 (b) (ii) PCT). Independent claims 1, 21, and 25 to 27 should therefore have been redrafted accordingly (see also PCT International Preliminary Examination Guidelines III-2.3a).
- 6 Reference signs in parentheses should have been inserted in all the claims to increase their intelligibility, Rule 6.2 (b) PCT. This applies to both the preamble and characterising portion (see also PCT International Preliminary Examination Guidelines III-4.11). Where a method claim makes reference to apparatus features, these should also have been accompanied by the respective reference signs wherever appropriate.
- 7 Contrary to the requirements of Rule 5.1 (a) (ii) PCT, the relevant background art disclosed in the documents D1 and D2 is not mentioned in the description, nor are

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00161

these documents identified therein. The documents D1 and D2 should therefore have been mentioned in the introductory portion of the description (see also the PCT International Preliminary Examination Guidelines II-4.4).

- 8 On page 13, line 28, a statement is made with regard to a prior art document which is to be incorporated in the application by reference. Since this prior art document does not appear to be essential to understand and carry out the invention of the instant application, the incorporation of this document is not necessary (see PCT International Preliminary Examination Guidelines II-4.17). Consequently, this statement should have been deleted (see Rule 9.1 (iv) PCT).
- 9 On page 13, line 28, reference is made to a prior patent application by its application number. For ease of reference, the application number should have been replaced by its publication number, which presumably is GB-A-234 19 63.

Re Item VIII

Certain observations on the international application

- 10 Although claims 1, 21, and 27, concerning an interface, respectively, and claims 25 to 26, concerning an interfacing method, respectively, have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection. Hence, claims 1, 21, and 27, and claims 25 to 26, do not meet the requirements of Article 6 PCT. An amended set of claims defining the relevant subject-matter in terms of a single claim in each category followed by dependent claims covering features which are merely optional should have been filed (Rule 6.4 PCT).
- 11 Claims 25 and 26 are not clear in the sense of Article 6 PCT because they apparently lack essential features. According to page 2, lines 1 to 5, it is the object

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00161

of the application to reduce the number of pins. However, none of the combination of steps of claims 25 or 26 necessarily leads to a reduced pin count. Therefore, essential features are apparently missing (see the PCT International Preliminary Examination Guidelines III-4.3).

- 12 Claim 27 is not clear in the sense of Article 6 PCT because it tries to define the interface by way of features relating to the use of the interface. In particular, the recitation "said time critical function being dependent upon whether the second connector is receiving or providing data" relates only to the use of the interface. A definition of the interface itself would have been possible (see the PCT International Preliminary Examination Guidelines III-4.8a).
- 13 Claim 10 is not clear in the sense of Article 6 PCT because it tries to define subject-matter using a negative statement. However, it appears to be possible to define the intended subject-matter using a positive statement. Clarification would have been required (see the PCT International Preliminary Examination Guidelines III-4.12).
- 14 The broad statement in the description on page 15, lines 1 to 2 implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a). The statement should thus have been deleted.

4 / 7

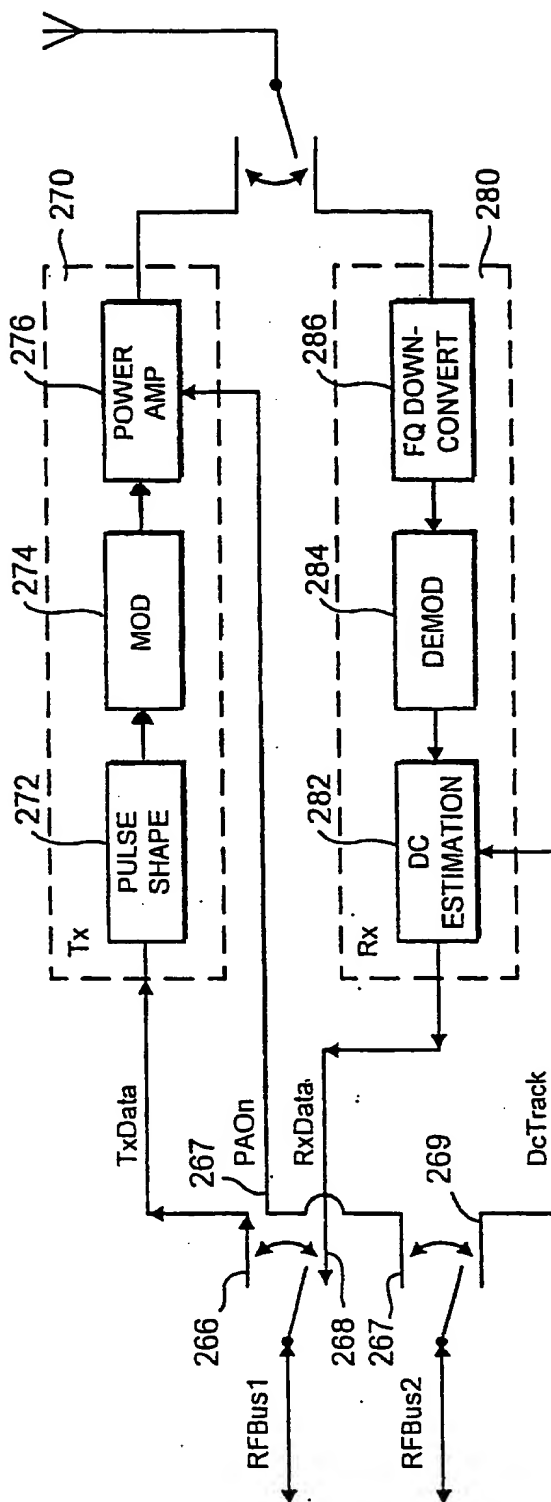


FIG. 1c

IN Tx Mode - SWITCHES UP
IN Rx Mode - SWITCHES DOWN

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

NOKIA IPR DEPARTMENT
 Nokia House
 Attn. HIGGIN, PAUL
 Summit Avenue, Southwood
 Farnborough
 Hamps. GU14 ONG
 UNITED KINGDOM

**NOTIFICATION OF TRANSMITTAL OF
 THE INTERNATIONAL SEARCH REPORT
 OR THE DECLARATION**

(PCT Rule 44.1)

Date of mailing
 (day/month/year)

27/06/2000

Applicant's or agent's file reference

PAT 99401PCT

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/GB 00/ 00161

International filing date

(day/month/year)

14/01/2000

Applicant

NOKIA MOBILE PHONES LIMITED et al.

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
 34, chemin des Colombettes
 1211 Geneva 20, Switzerland
 Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
 NL-2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Liliane Van Velzen-Peron

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PAT 99401PCT	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 00161	International filing date (day/month/year) 14/01/2000	(Earliest) Priority Date (day/month/year) 15/01/1999
Applicant NOKIA MOBILE PHONES LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1a

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/00161

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04L12/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	<p>US 5 365 546 A (FREDE WILLIAM W ET AL) 15 November 1994 (1994-11-15)</p> <p>abstract</p> <p>column 4, line 55 -column 18, line 26; claim 7 figures 4-6</p> <p style="text-align: center;">--- -/--</p>	<p>1-6, 8, 11-13, 18, 20-25, 27 7, 9, 10, 14-17, 19, 26</p>

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

16 June 2000

Date of mailing of the international search report

27/06/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Fax: (+31-70) 340-3016

Authorized officer

Tzimeas, K

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/00161

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 636 140 A (LEE DENNIS ET AL) 3 June 1997 (1997-06-03)	1-3, 5, 6, 8, 11-14, 18, 19, 21, 24, 27
A	abstract column 4, line 28 -column 7, line 48 claims 1-7; figures 3, 4, 5B -----	4, 7, 9, 10, 15-17, 20, 22, 23, 25, 26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/00161

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5365546 A	15-11-1994	US 5052020 A	24-09-1991
		US 5555276 A	10-09-1996
		US 5657317 A	12-08-1997
		US 5790536 A	04-08-1998
		US 5726984 A	10-03-1998
		US 5912926 A	15-06-1999
		US 5949776 A	07-09-1999
		CA 2074169 A	19-07-1991
		EP 0511295 A	04-11-1992
		US 5331136 A	19-07-1994
		WO 9111065 A	25-07-1991
		US 5680633 A	21-10-1997
		US 5567925 A	22-10-1996
		US 5679943 A	21-10-1997
		US 5949056 A	07-09-1999
		US 5218187 A	08-06-1993
		US 5313053 A	17-05-1994
US 5636140 A	03-06-1997	EP 0846385 A	10-06-1998
		WO 9708872 A	06-03-1997



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H04L 12/56

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(11) International Publication Number:

WO 00/42744

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9928574.4	3 December 1999 (03.12.99)	GB
9928856.5	7 December 1999 (07.12.99)	GB

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(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

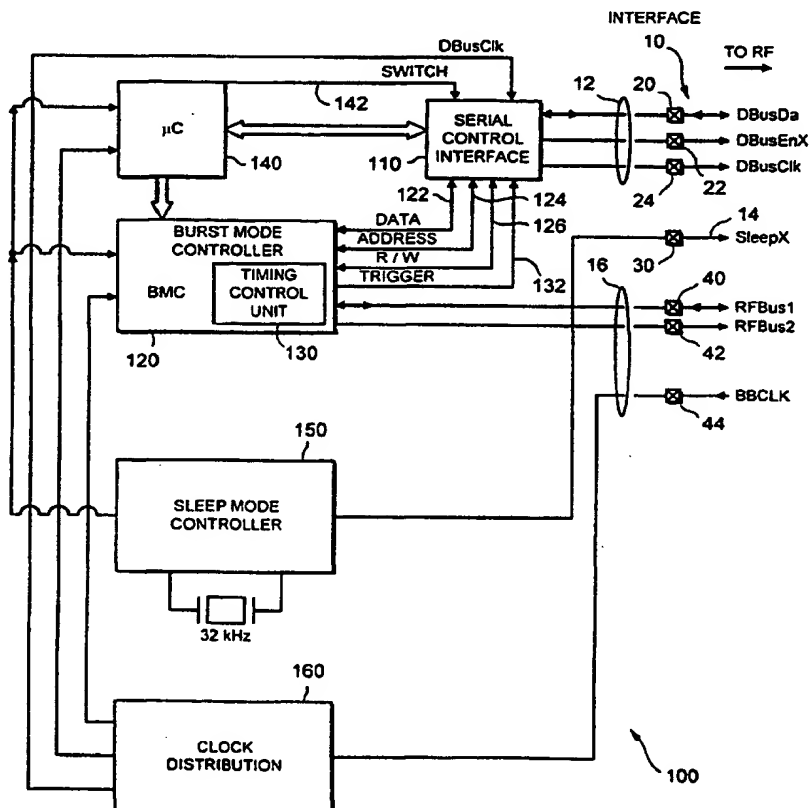
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: INTERFACE

(57) Abstract

An interface between base band circuitry and RF transceiver circuitry, particularly relating to the Bluetooth standard. The interface has a plurality of connectors (DBus) for controlling the RF transceiver circuitry including providing control information for changing the mode of operation of the transceiver, said modes including a transmit mode and a receive mode; at least first and second further connectors (RFBus) wherein in the transmit mode, one of said first and second connectors supplies data to the transceiver and the other is operable to perform a first function such as controlling the power amplifier in the RF circuitry and wherein, in the receive mode, one of said first and second connectors receives data from said RF module and the other is operable to perform a second function different from the first function.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
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DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

Interface

5 The present invention relates to an interface between base band circuitry and radio frequency transceiver circuitry, particularly circuitry operating in accordance with the Bluetooth Low Power Radio Frequency Specification. It additionally relates to devices having such an interface and either type of circuitry.

10

Low power radio frequency systems allow communication between devices over short distances typically ten's of meters. The devices must each be capable of receiving and transmitting according to the system's protocol.

15 One low power radio frequency system is the Bluetooth system. This system is designed to replace connecting wires and cables with wireless connectivity. For one device to communicate with another device, no wires connecting them will be necessary. Instead, each device will host a transceiver. A transceiver has a baseband part and an RF part. The host itself may have
20 processing circuitry which is capable of doing the base band processing and that host will only require RF transceiver circuitry to be correctly connected to that processing circuitry.

It would be desirable to create RF transceiver circuitry that can be connected
25 to many different hosts to provide the hosts with wireless connectivity.

It would be desirable to standardize the interface at which the connection between the base band circuitry and the transceiver circuitry is made making it vendor and platform independent.

30

It would be desirable to have a simple interface between the baseband part and the radio frequency part and in particular to have a reduced number of pins in the interface. A reduced number of pins provides the advantages of reduced chip area and reduced power consumption due to less toggling of pins.

According to one aspect of the present invention there is provided a device as claimed in claim 1.

10 According to another aspect of the invention there is provided transceiver circuitry as claimed in claim 21.

According to further aspects of the invention there is provided a method according to any one of claims 25 and 26.

15 According to a still further aspect of the invention there is provided an interface as claimed in claim 27.

Embodiments of the present invention therefore provide an interface with a low pin count and attendant low power consumption.

The low pin count arises out of: the burst mode controller and the microcontroller both using the DBus; the burst mode controller using the DBus for different tasks and the function of the RFBUS being dependent upon the operational mode.

25 The burst mode controller controls time critical tasks in the RF circuitry using the DBus and RFBUS. The DBus is used to control time critical configurations. The RFBUS is used to transfer data and, in the transmit mode, to control the power amplifier.

For a better understanding of the present invention and to understand how the same may be brought into effect reference will now be made, by way of example only, to the accompanying tables and figures in which:

- 5 Table 1 illustrates the signals provided at the interface between Baseband (BB) circuitry and Radio Frequency (RF) circuitry;

Table 2 illustrates the effect of operational modes on the signals provided at the interface via RFBus;

Figure 1a illustrates the BB side of the RF-BB interface;

- 10 Figure 1b illustrates the RF side of the RF-BB interface;

Figure 1c is a schematic illustration of a LPRF transceiver illustrating the functionality of RFBus;

Figure 2a illustrates how RFBus is configured and how the RF chip responds in the control mode;

- 15 Figure 2b illustrates how RFBus is configured and how the RF chip responds in the transmit mode;

Figure 2c illustrates how RFBus is configured and how the RF chip responds in the receive mode;

Figure 3 illustrates how the DBus may control devices in addition to an LPRF

- 20 RF chip having RF circuitry;

Figure 4a illustrates Write Access on DBus;

Figure 4b illustrates Read Access on DBus.

- Figure 1a illustrates baseband (BB) circuitry 100 having an interface 10. The
25 interface is connected or connectable to a similar corresponding interface 10 of radio frequency (RF) circuitry 200 illustrated in Figure 1b.

- The interface 10 has seven pins. The pins 20, 22 and 24 are assigned to the bus of control signals DBus 12 and respectively transfer the signals DBusDa,
30 DBusEnX and DBusClk. The pin 30 is assigned to the sleep control signal

SleepX 14 . The pins 40, 42 and 44 are assigned to the bus of data signals RFBUS 16 and respectively transfer the signals RFBUS1, RFBUS2 and BBCLK. The pins of the interface 10 in the BB circuitry connect or are connectable to corresponding pins of the interface 10 of the RF circuitry 200.

5

The DBUS 12 has three signal lines associated with the pins 20, 22 and 24. A bi-directional signal line for transferring data signal DBUSDa either from BB circuitry 100 to RF circuitry 200 or from RF circuitry 200 to BB circuitry 100, via pin 20. A unidirectional signal line for transferring an enable signal DBUSEnX from the BB circuitry 100 to RF circuitry 200, via pin 22. A unidirectional signal line for transferring a clock signal DBUSCLK from the BB circuitry 100 to RF circuitry 200, via pin 24.

The RFBUS 16 has three signal lines associated with the pins 40, 42 and 44. A bi-directional signal line for transferring signal RFBUS1 via pin 40. A unidirectional signal line for transferring a clock signal BBCLK from the RF circuitry 200 to BB circuitry 100 via pin 44. A unidirectional signal line for transferring signal RFBUS2 from BB circuitry 100 to RF circuitry 200 via pin 42. SleepX 14 is a unidirectional signal line for transferring from the BB circuitry 100 a signal SleepX for controlling power-down in the RF circuitry 200.

Table 1 illustrates the signals provided at the interface 10 and identifies each one of the interface signals by their associated interface pin, their name, their direction and their function.

DBus

DBus 12 is a serial I/O Data Bus. It is a Clock, Data, Enable serial interface. It is not dedicated purely to the interface 10 between the RF circuitry 200 and the BB circuitry 200. Figure 3, illustrates the situation in which the BB circuitry

100 is integrated into another host system. The BB circuitry 100 is the DBus Master. In this example the host system is a radio telephone 300, but it could be a computer or personal digital assistant (PDA). The DBus 12 communicates with DBus Slaves. One DBus Slave is the RF circuitry 200 which is connected to DBus via the interface 10. Other slaves communicated with are in the example illustrated Power Supply Management Circuitry 310 and RF Modulator Circuitry 320 for the GSM protocol.

The DBus (DBusDa, DBusEnX and DBusClk) is used to control the RF circuitry and other devices as illustrated in Figure 4. The DBus writes control data to and reads control data from registers in the RF circuitry 200. The registers written to may include a register which controls the frequency at which the RF chip transmits or receives, a register which controls the power at which the RF chip transmits and registers which identify whether the RF chip is in the control, transmit or receive mode. The registers read from may include a register containing RSSI information. Thus the DBus may control the operation of the RF circuitry, for example, controlling the transition from receiving to transmitting.

The BB circuitry 100 controls access to the DBus. The BB circuitry precedes transferred data words with a device address, a Read/Write (R/W) identification bit and a register address. Each device address is 3 bits long allowing for 8 devices (the RF circuitry 200 and 7 others) to be accessed. The R/W bit when LOW indicates the BB circuitry is to write to the addressed register and when HIGH indicates that the BB circuitry is to read from the addressed register. The register address is 5 bits long allowing 32 registers to be addressed. The data words may be of variable length and may have a practical limit of 32 bits. Data words of 16 bits are preferred for transfer to/from the RF circuitry 200.

Address bits and R/W bit are verified before latching data to permit bus sharing with devices which are used concurrently to RF circuitry 200.

Access via DBus is enabled by taking DBusEnX LOW half a clock cycle before the first positive clock edge of DBusClk. At the first rising edge of DBusClk the MSB of the device address will be clocked from DBusDa into the DBus Slave.

A write access is illustrated in Figure 4b. To write to RF circuitry 200 the DBus Master circuitry 100 places data onto DBusDa at the falling edge of DBusClk. The DBus Slave 200 having verified that it is addressed takes data from DBusDa on each of the rising edges of DBusClk. The DBus Master 100 changes the state of data at the falling edge of each clock pulse of DBusClk. Following the 8 address bits and R/W bit, data bits are sent with the same timing as the address bits. Following the last data bit the enable line DBusEnX is taken HIGH. The clock then pulses one more pulse and is then held LOW for a minimum of one cycle before a new access may be started. The enable DBusEnX is therefore held HIGH for a minimum of two cycles.

A read access is illustrated in Figure 4a. The DBus Slave when being read from, places data onto DBusDa on each of the rising edges of DBusClk. The data is read from DBusDa by the DBus Master 100 on each of the falling edge of DBusClk. During a read access the addressed device generates data on the DBus to be read by the controlling device. Following the 8 address bits and R/W bit there is a turn around bit which lasts for half a clock cycle and has the effect of realigning the DBus timing such that the addressed device will load bits onto the DBus upon the rising edge of the DBusClk. The bits are read at the DBus Master 100 on the falling edges of the DBusClk. Following the last data bit the DBusClk is disabled for at least one clock cycle before the next access. The data word length is not fixed. The DBus Master 100 controls

DBusEnX. The number of data bits and the data word length is fixed for a certain address by convention.

RFBus

- 5 The interface 10 has a dedicated pin for signal RFBus1, a dedicated pin for signal RFBus2; and a dedicated pin for clock signal BBClk (13MHz), used to synchronize data transferred via RFBus. BBClk may also be used for clocking logic of BB circuitry 100. BBClk is generated by RF circuitry 200 at 13MHz for symbol rate of 1Mbaud @ 13 fold oversampling.

10

- The RFBus 16 is multifunctional. RFBus is used for transferring received data from the RF circuitry 200 to the BB circuitry 100, transferring data for transmission from the BB circuitry 100 to the RF circuitry 200 and transferring control data between the BB circuitry 100 and RF circuitry 200. The ability of
15 the RFBus to transfer control data is used for different purposes depending upon the operational mode of the system.

- RFBus 1 is bi-directional. In a Transmit mode the RFBus 1 provides data to the RF circuitry 200 for transmission. In a Receive Mode RFBus 2 receives
20 data from the RF circuitry 200. Although in the examples given a single data signal RFBus1 is illustrated a plurality of such data signals may be used to increase bandwidth.

- RFBus 2 is used to control time critical tasks in the RF circuitry 200. Time
25 critical tasks are tasks which need to be effected on a time scale of less than 1 bit width (1 μ s in Bluetooth). RFBus2 is fast (13 MHz) at transmitting control signals from the BB circuitry 100 to the RF circuitry 200. In the Transmit mode, RFBus2 is used to control the timing of the Power Amplifier. In the Receive Mode RFBus 2 is used to control the timing of the DC estimator
30 changing from a fast data acquisition mode to a slower data acquisition mode.

The operational mode of the system is determined by the BB circuitry 100. The BB circuitry indicates a change of mode to the RF circuitry 200 via DBus. The modes include Transmit Mode, Receive Mode and Control Mode.

5

Interface of BB circuitry

The BB circuitry illustrated in Figure 1a has the interface 10 previously described, it additionally has a Serial Control Interface 110, a Burst Mode Controller (BMC) including a Timing Control Unit 130, a microcontroller 140, a sleep mode controller 150 and clock distribution circuitry (CDC) 160. The Serial Control Interface 110 provides DBus at pins 20, 22 and 24. The Burst Mode Controller 120 provides RFBUS1 at pin 40 and RFBUS2 at pin 42. The Sleep Mode Controller provides SleepX at pin 30. The Clock Distribution Circuitry 160 is connected to pin 44 of interface 10 and receives BBCLK from the RF circuitry 200.

The CDC 160 provides clock signals derived from BBCLK to the BMC 120, the microcontroller 140 and the Serial Control Interface 110.

The Serial Control Interface 110 is controlled to produce DBus by either the microcontroller 140 or the Burst Mode Controller 120. The Burst Mode Controller controls DBus when time critical configurations to RF circuitry 200 are made. Whether the microcontroller 140 or the BMC 120 controls the content of DBus is determined by a switch signal 142 provided by the microcontroller 140 to the Serial Control Interface 110. The BMC 120 provides Data information 122, address information 124 and R/W information 126 to the Serial Control Interface 110 which places this information in the correct serial format on DBusDa. The clock signal DBusClk (13MHz) is received from Clock Distribution Circuitry. The timing of the transitions in the

Enable signal DBusEnX are controlled by a Trigger signal 132 provided by the Timing Control Unit 130 in the BMC 120.

5 The Burst Mode Controller 120 controls the content of RFBus1 and RFBus2 and may additionally control the content of DBus. It directly provides RFBus2 to pin 42 and provides RFBus1 to pin 40 in the Transmit Mode and receives RFBus1 from pin 40 in the Receive Mode.

10 The microcontroller may access the DBus and hence the RF circuitry via the Serial Control Interface. When the DBus is controlled by the microcontroller no time critical tasks can be controlled via the DBus. This configuration is used in the boot phase or for RSSI measurement. When the BMC 120 controls the DBus, it is possible to control time critical tasks via the DBus. The ability of the BMC 120 to control time critical tasks via the DBus depends
15 upon the resolution of the trigger signal 132 which is at least 1 μ s. The control signals sent by the BMC 120 via RFBus2 may have an even higher resolution if they are directly clocked by BBClk @ 13MHz.

Interface of RF circuitry

20 Fig 1b illustrates the RF circuitry 200 which has an interface 10. The interface has pins 20, 22 and 24 dedicated respectively to DBusDa, DBusEnX and DBusClk, pin 30 dedicated to SleepX and pins 40, 42 and 44 respectively dedicated to RFBus1, RFBus2 and BBClk. The RF circuitry 200 includes a Control Interface 210; a register set 220 illustratively including registers 222,
25 224 and 226; decoding circuitry 230; a NOT gate 232; a two input AND gate 234; a three input OR gate 236; power-supply regulator circuitry 240; a reference oscillator 250; switching circuitry 260; Transmission Path 270 and Reception Path 280.

The Control Interface 210 has an input interface 212 connected to DBus and a input 214 for receiving Sleep X. It has an output 216 for supplying a mode control signal to the input of decoding circuitry 230 and to the control input 262 of the switching circuitry 260 and an interface 218 for accessing the set of registers 220. The Control Interface 210 receives DBus and performs the appropriate action which may involve writing to a register or reading from a register and changing the mode of operation of the RF circuitry 200. By writing to appropriate registers the Control Interface 210 may control the operational mode of the RF circuitry 200, control the synthesizer frequency in the Tx or Rx path, control whether the RF circuitry should receive or transmit, and control the power at which the Tx path 270 should transmit. By reading from appropriate registers information concerning received signal quality such as RSSI can sent by the Control Interface 210 to the BB circuitry 100. For simplicity of illustration the operative connections of the Rx Path 280 and Tx Path 210 to the register set 220 are not shown. A two bit signal is provided at the output 216 indicating the operational mode- [10] indicates Receive Mode, [01] indicates Transmit Mode and [11] indicates Control Mode.

The switching circuitry 260 has an input 262 connected to output 216 of the Control Interface 210, a single primary interface and three secondary interfaces. The primary interface has one port connected to pin 40 to transfer RFBUS1 and another port connected to pin 42 to transfer RFBUS2. One of the secondary interfaces is connected at any one time to the primary interface in dependence on the signal received at the input 262. When the signal at input 262 indicates Control Mode a port 264 of a first one of the secondary interfaces is connected to pin 40 via the switching circuitry 260. The port 264 is connected to one input of the AND gate 234. When the signal at input 262 indicates Transmit Mode a port 266 of a different one of the secondary interfaces is connected to pin 40 via the switching circuitry 260 and the other port 267 of that secondary interface is connected to pin 42 via the switching

circuitry 260. When the signal at input 262 indicates Receive Mode a port 268 of another of the secondary interfaces is connected to pin 40 via the switching circuitry 260 and the other port 269 of that secondary interface is connected to pin 42 via the switching circuitry 260. The ports 266 and 267 and 268 and 269 are connected to the Tx Path 270 and Rx Path 280 respectively as further illustrated in Figure 1c.

The decoding circuitry 230 has a 2 bit wide input connected to the output 216 of the Control Interface 210 and provides its output to one input of AND gate 234 and, via NOT gate 232, to one input of OR gate 236. The decoding circuitry 230 produces a HIGH output when the signal received at its input identifies the Control Mode and a LOW signal otherwise.

The OR gate receives one input via the NOT gate 232 as described, another input from the pin 30 which receives SleepX and a final input from the output of AND gate 234. The output of the OR gate 236 is provided as a standby control signal to the Power-Supply Regulation Circuitry 240 and to the Reference Oscillator 250. A LOW output from the OR gate 236 places Power-Supply Regulation Circuitry 240 into a low power consumption standby state and switches the Reference Oscillator 250 off.

The Reference Oscillator 250 provides its output to the pin 44. It's output is also used elsewhere within the RF circuitry, but this is not illustrated for purposes of clarity.

Figure 1c illustrates the control effected on the Tx path 270 during Transmit Mode and the control effected on the Rx Path 280 during Receive Mode.

The Transmit path 270 includes Pulse Shaping Circuitry 272 which receives an input from port 266 of switching circuitry 260 in the Transmit Mode and

otherwise does not receive an input. The output of the Pulse Shaping Circuitry 272 is provided as an input to Modulation Circuitry 274 which provides the modulated signal to Power Amplifier 276 for amplification and subsequent transmission via an antenna. The power Amplifier 276 has a control input by which the amplifier gain may be forced to ramp up or ramp down. This control input is connected to port 267 of the switching circuitry 260. The power amplifier can therefore be switched on or off.

The Receive Path 280 includes Frequency Down Conversion Circuitry 286 which receives an input from the antenna in the Receive Mode. The circuitry 286 converts the received signal to a lower frequency and provides it to Demodulation Circuitry 284. The demodulated signal is provided to DC estimation circuitry 282. The amplitude decided data output by DC Estimation circuitry 282 is supplied to the port 268 of the switching circuitry 260. The DC Estimation Circuitry 282 has a control input connected to the port 269 of switching circuitry 260. The signals provided at the control input determine whether the DC Estimation operates in a fast mode or a slow mode.

Operational Modes

In the Transmit Mode, as illustrated in Figure 2b, RFBUS1 and RFBUS2 are driven by BB circuitry 100. RFBUS1 supplies digital data for transmission <TXDATA> from BB circuitry 100 to RF circuitry 200 via pin 40. Logic levels are used and pulse shaping is done completely in RF circuitry 200. RFBUS2 controls the timing of powering up the Power Amplifier (PA) in the RF circuitry 200 using control signal <PAON>. When RFBUS2=<PAON>=HIGH the Power Amplifier is on when RFBUS2=<PAON>=LOW the Power Amplifier is off. The switching on and off of the Power Amplifier is 'time critical' as it must be controlled over time scales of less than 1 bit duration (1 μ s for Bluetooth Specification 1.0).

In Receive Mode, as illustrated in Figure 2c, RFBus1 is driven by RF circuitry 200 and RFBus2 driven by BB circuitry 100. RFBus1 supplies received data <RXDATA> to the BB circuitry 100 via pin 40. RFBus2 controls DC estimation in RF circuitry 200 via pin 42. The switching of DC estimation is 'time critical' as it occurs on a time scale of less than 1 slot duration. <DCTRACK>=LOW cause use of a fast acquisition of a DC estimate which is typically used at the start of a received packet and <DCTRACK>=HIGH controls use of a slower DC estimation which is typically used for the remainder of the packet. The change of DC estimation is 'time critical' as it must be controlled over time scales of less than 1 bit duration (1 μ s for Bluetooth Specification 1.0).

The Control Mode is the neutral mode entered when neither the Transmit Mode or Receive Mode are active. It is entered when SleepX is LOW or via a control word on DBus. In this mode, as illustrated in Figure 2a, RFBus1 and RFBus2 are driven by BB circuitry 100: RFBus2 does not have an assigned functionality; RFBus1= <ClkOn>. When RFBus1=<ClkOn>=HIGH, AND gate 234 switches ON the Reference Oscillator 250 and the Power Supply Regulation Circuitry 240. When RFBus1=<ClkOn>=LOW, AND gate 234 switches OFF the Reference Oscillator 250 and the Power Supply Regulation Circuitry 240 into standby. The RF circuitry is placed in a low power mode. There is no activity on DBus and RFBus and BBclk is switched off.

It will therefore be appreciated that the RFBus is used for different purposes during different operational modes of the system, as illustrated in Figures 2a, 2b, and 2c and Table 2.

The operation of a LPRF device is described in detail in UK Patent Application No 9820859.8 , the contents of which are hereby incorporated by reference. In particular Figure 4 shows LPRF RF components of a transceiver (Tx, Rx

and Frequency control), connected to baseband components (the remaining elements in the Figure).

5 In the preceding described embodiment, the receive path 280 was partitioned so that the DC Estimation circuitry 282 was in the RF Circuitry 200. This results in RFBus1, during the receive mode, transferring RxData from the RF Circuitry 200 to the BB circuitry 100 across interface 10 and RFBus2 transferring a control signal, DcTrack, from the BB circuitry 100 to RF Circuitry 200 across interface 10. This partitioning of the receive path is not essential.

10

In a second contemplated embodiment, the DC Estimation circuitry 282 is located within the baseband circuitry 100. This results in RFBus2 having a different directional flow than described above in the receive mode. In the second embodiment, the DcTrack signal is wholly within the baseband circuitry 100 and is not provided at the interface 10. The analog output of the demodulator 284 is converted to a digital signal for example by a sigma-delta converter whose outputs are mapped to RFBus1 and RFBus2. Consequently, in this embodiment, data flows on both RFBus1 and RFBus2 from the RF circuitry 200 to the baseband circuitry 100 via interface 10 during the receive mode.

20

It is further contemplated that RF circuitry as described in the first embodiment may have additional circuitry which allows its functionality to be changed to operate in accordance with the second embodiment.

25

It is further contemplated that BB circuitry as described in the first embodiment may have additional circuitry which allows its functionality to be changed to operate in accordance with the second embodiment.

15

The present invention includes any novel feature or combination of features disclosed herein either explicitly or implicitly or any generalization thereof.

5 In view of the foregoing description it will be evident to a person skilled in the art that various modifications may be made to the foregoing description without departing from the scope of the invention.

Claims

1. A device having an interface for controlling RF transceiver circuitry, the
5 interface having:
a plurality of connectors for controlling the RF transceiver circuitry including
providing control information for changing the mode of operation of the
transceiver, said modes including a transmit mode and a receive mode;
at least first and second further connectors wherein in a first mode, one of
10 said first and second connectors supplies data to the transceiver and the
other is operable to perform a first function and wherein, in the second mode,
one of said first and second connectors receives data from said RF module
and the other is operable to perform a second different function.
- 15 2. A device as claimed in claim 1 wherein said first function is the provision of
a first control signal to the transceiver
3. A device as claimed in claim 2 wherein the first control signal is a time
critical control signal.
- 20 4. A device as claimed in any preceding claim wherein the first function is
controlling the power amplifier of the transmitter portion of the transceiver.
5. A device as claimed in any preceding claim wherein said second function
25 is the provision of a second control signal to the transceiver.
6. A device as claimed in claim 5 wherein the second control signal is a time
critical control signal.

7. A device as claimed in any preceding claim wherein the second function is controlling dc estimation of the data received by the receiving portion of the transceiver.

5

8. A device as claimed in any one of claims 1 to 4 wherein said second function is the reception of data from the transceiver

9. A device as claimed in any preceding claim wherein the first connector is
10 bi-directional and supplies data in the first mode and receives data in the second mode.

10. A device as claimed in any preceding claim wherein predetermined time critical control signals are not provided via said plurality of connectors.

15

11. A device as claimed in any preceding claim wherein the first mode is a transmit mode for the transceiver.

12. A device as claimed in any preceding claim wherein the second mode is a
20 receive mode of the transceiver.

13. A device as claimed in any preceding claim wherein the plurality of connectors includes a connector for transferring data to and from the device, a connector for providing, an enable signal from the device and a connector
25 for providing a clock signal from the device.

14. A device as claimed in any preceding claim wherein the plurality of connectors are used to read from and write to registers in the transceiver

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15. A device as claimed in any preceding claim wherein the plurality of connectors is a serial interface having at least one connector via which data is transmitted serially, said data including a device address, a bit indicating whether data is for writing or is to be read, a local address and a variable data
5 portion.

16. A device as claimed in any preceding claim, further comprising first control circuitry and a processor, wherein the first control circuitry is arranged to
10 control the RF circuitry via the plurality of connectors and/or the first and second further connectors and the processor is arranged to control the RF circuitry only via the plurality of connectors.

17. A device as claimed in claim 15 wherein the data portion may have a
15 length varying between 1 and 32 bits.

18. A device as claimed in any preceding claim wherein the plurality of connectors are coupled to at least one other device.

19. A device as claimed in any preceding claim further comprising a connector
20 for receiving a clock signal from the transceiver.

20. A device as claimed in any preceding claim having a third connector
(SleepX) for powering down components of the transceiver.

21. Transceiver circuitry having an interface for connection to a device having
25 baseband circuitry, the interface having:

a plurality of connectors for providing control information for changing the
mode of operation of the transceiver, said modes including a transmit mode
30 and a receive mode;

at least first and second connectors wherein in a first mode, data is received at one of said first and second connectors and the other performs a first function and wherein, in the second mode, data is provided at one of said first and second connectors for transfer to the device and the other performs a second function different to the first.

22. Transceiver circuitry as claimed in claim 21 having a power amplifier, wherein the first function is the reception of a first control signal for controlling the power amplifier.

23. Transceiver circuitry as claimed in claim 21 or 22 having DC estimation circuitry wherein the second function is the reception of a second different control signal for controlling the dc estimation circuitry.

24. Transceiver circuitry as claimed in claim 21 or 22 wherein the second function is the provision of received data.

25. A method of interfacing a device having baseband circuitry to transceiver circuitry, the device having means for controlling whether the transceiver is in a transmitting mode or a receiving mode and first and second connectors, comprising the steps of:

controlling the transceiver to enter the transmitting mode;
providing data from the device to the transceiver via the first connector; and
controlling the power amplifier in the transceiver via the second connector.

26. A method of interfacing a device having a baseband engine to a transceiver, the device having means for controlling whether the transceiver is in a transmitting mode or a receiving mode and first and second connectors, comprising the steps of:

controlling the transceiver to enter the receiving mode;

20

receiving data at the device from the transceiver via the first connector; and
controlling the dc estimation in the transceiver via the second connector.

27. An interface having connectors including a first connector arranged to
5 transfer a signal for controlling time critical functions and a second connector
arranged to transfer data, said time critical function being dependent upon
whether the second connector is receiving or providing data.

10

TABLE 1:
SUMMARY OF THE INTERFACE SIGNALS

PIN	NAME	DIRECTION	FUNCTION
20	DBusDa	BIDIRECTIONAL	CONTROL INTERFACE: DATA
24	DBusClk	BB -> RF	CONTROL INTERFACE: CLOCK
22	DBusEnX	BB -> RF	CONTROL INTERFACE: ENABLE
40	RFBUS1	BIDIRECTIONAL	DATA INTERFACE: LINE 1
42	RFBUS2	BB -> RF	DATA INTERFACE: LINE 2
44	BBCLK	RF -> BB	DATA INTERFACE: CLOCK (e.g. 13 MHz)
30	SleepX	BB -> RF	SLEEP-MODE CONTROL & REST

TABLE 2:
OPERATING MODES AND THEIR INFLUENCE ON THE DATA INTERFACE

MODE NAME	FUNCTIONALITY OF RFBUS1	FUNCTIONALITY OF RFBUS2	DIRECTION OF RFBUS1	DIRECTION OF RFBUS2
CONTROL MODE	<CLKON>	0	BB → RF	BB → RF
TRANSMIT MODE	<TXDATA>	<PAON>	BB → RF	BB → RF
RECEIVE MODE	<RXDATA>	<DCTACK>	BB ← RF	BB → RF

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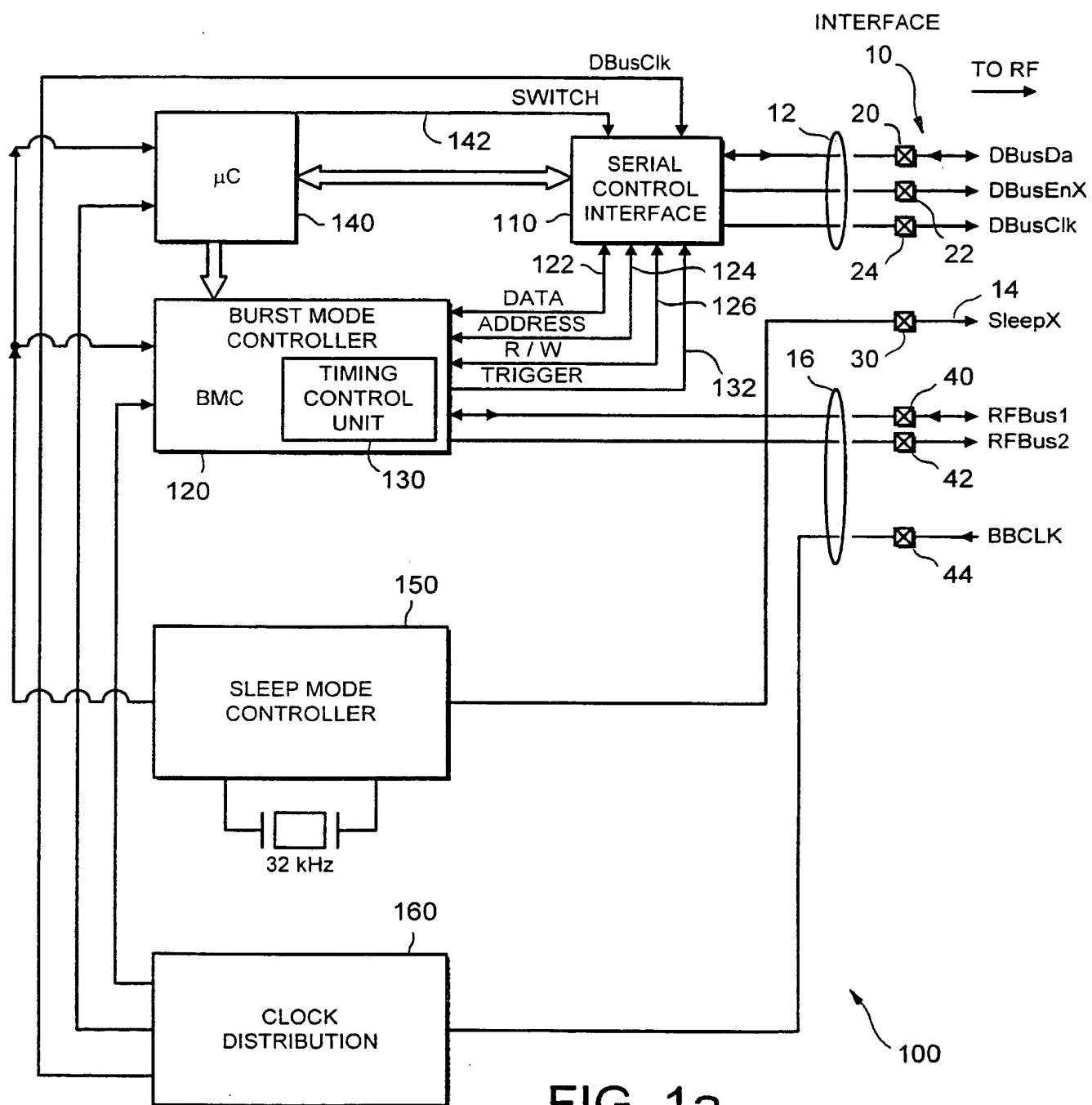


FIG. 1a

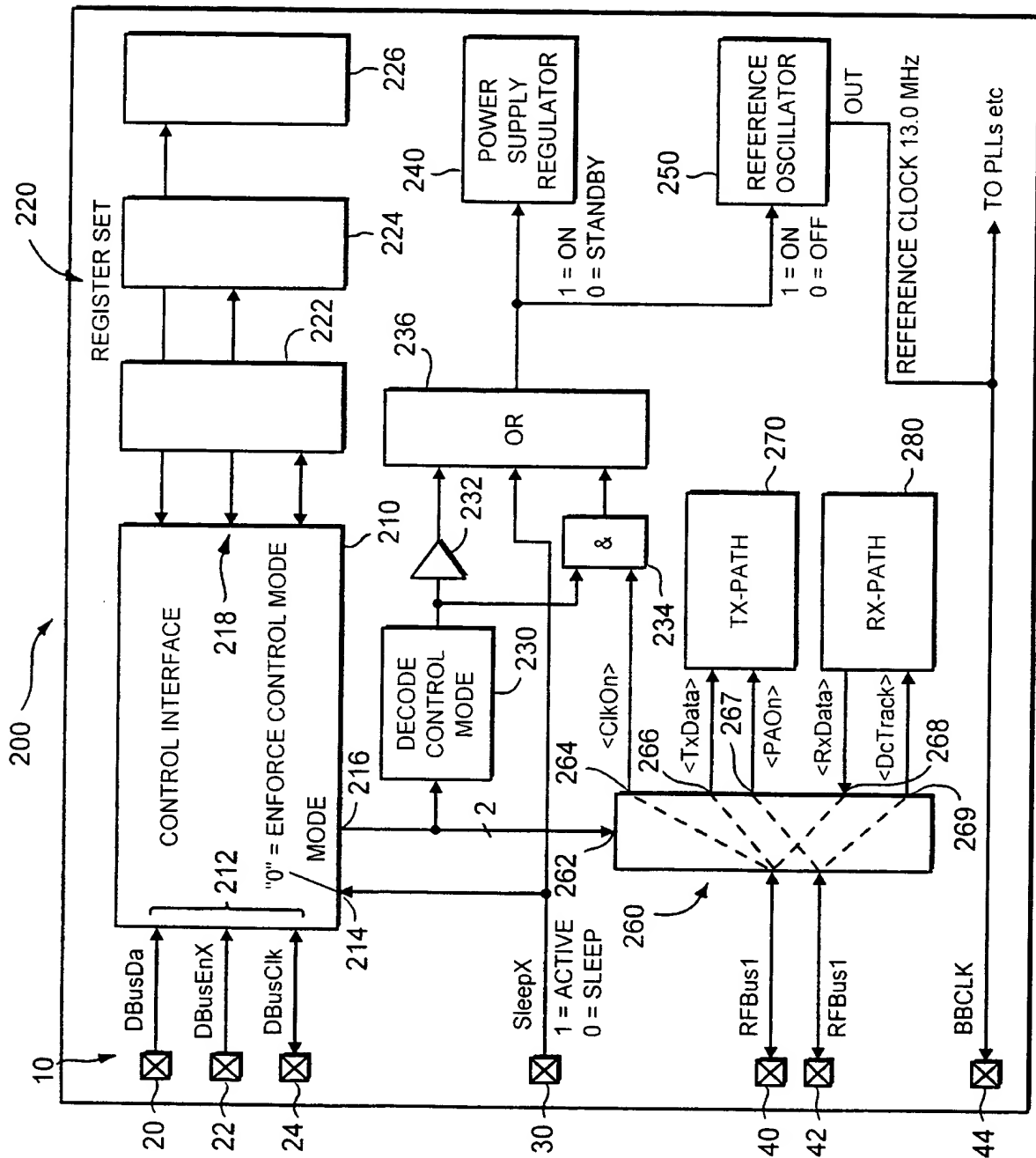


FIG. 1b

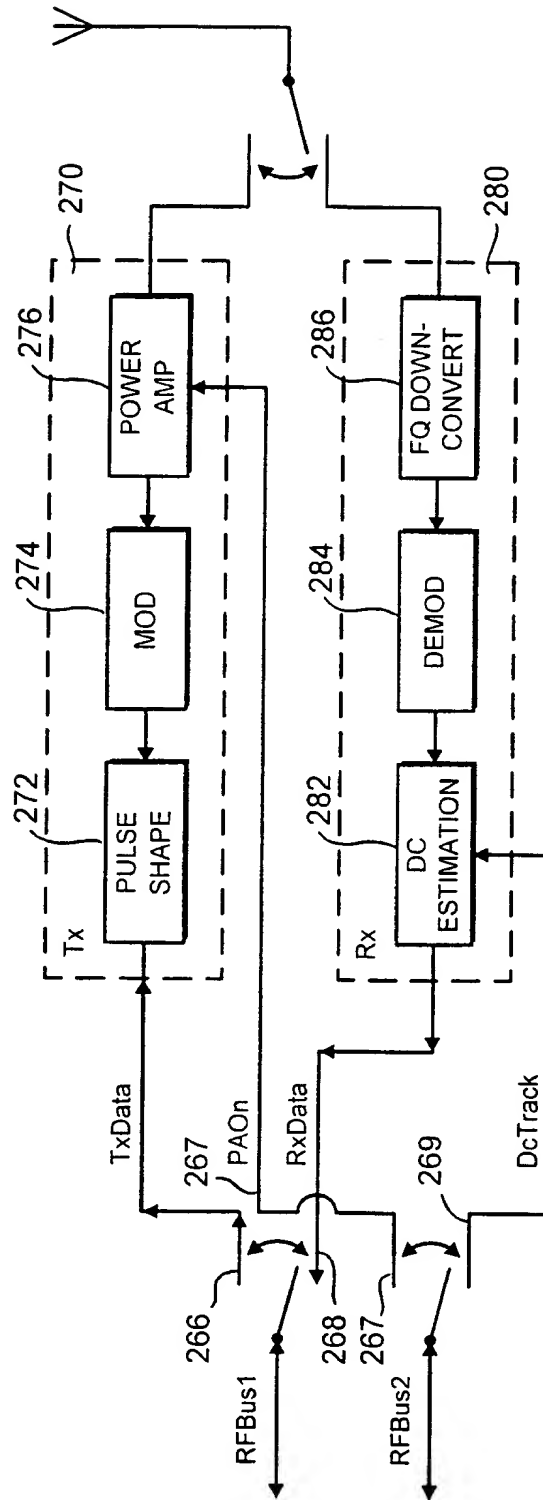


FIG. 1c

IN Tx Mode - SWITCHES UP
 IN Rx Mode - SWITCHES DOWN

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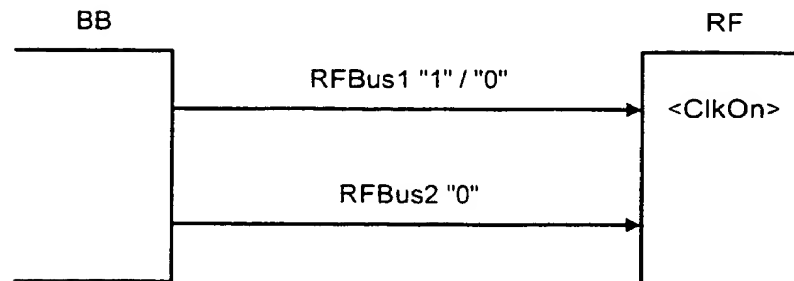
CONTROL MODE OF RF TRANSCEIVER

FIG. 2a

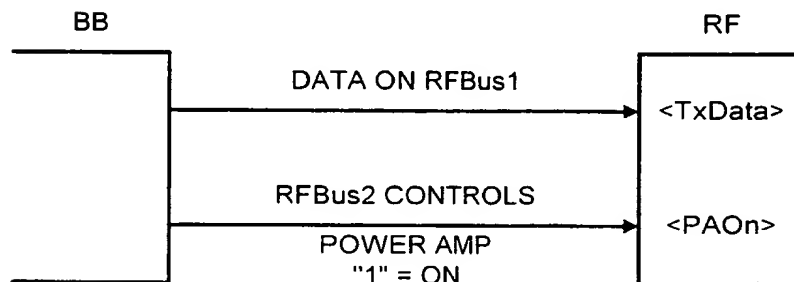
TRANSMIT MODE OF RF TRANSCEIVER

FIG. 2b

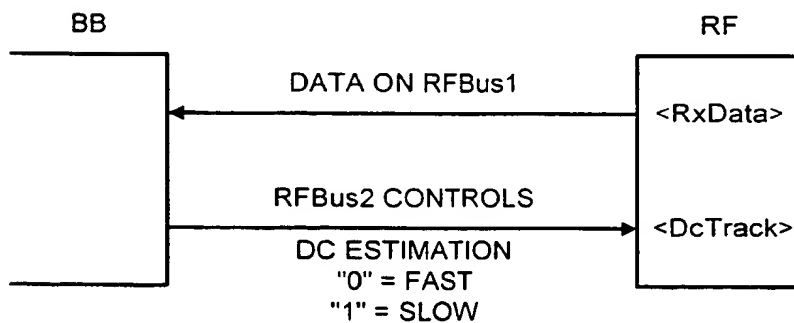
RECEIVE MODE OF RF TRANSCEIVER

FIG. 2c

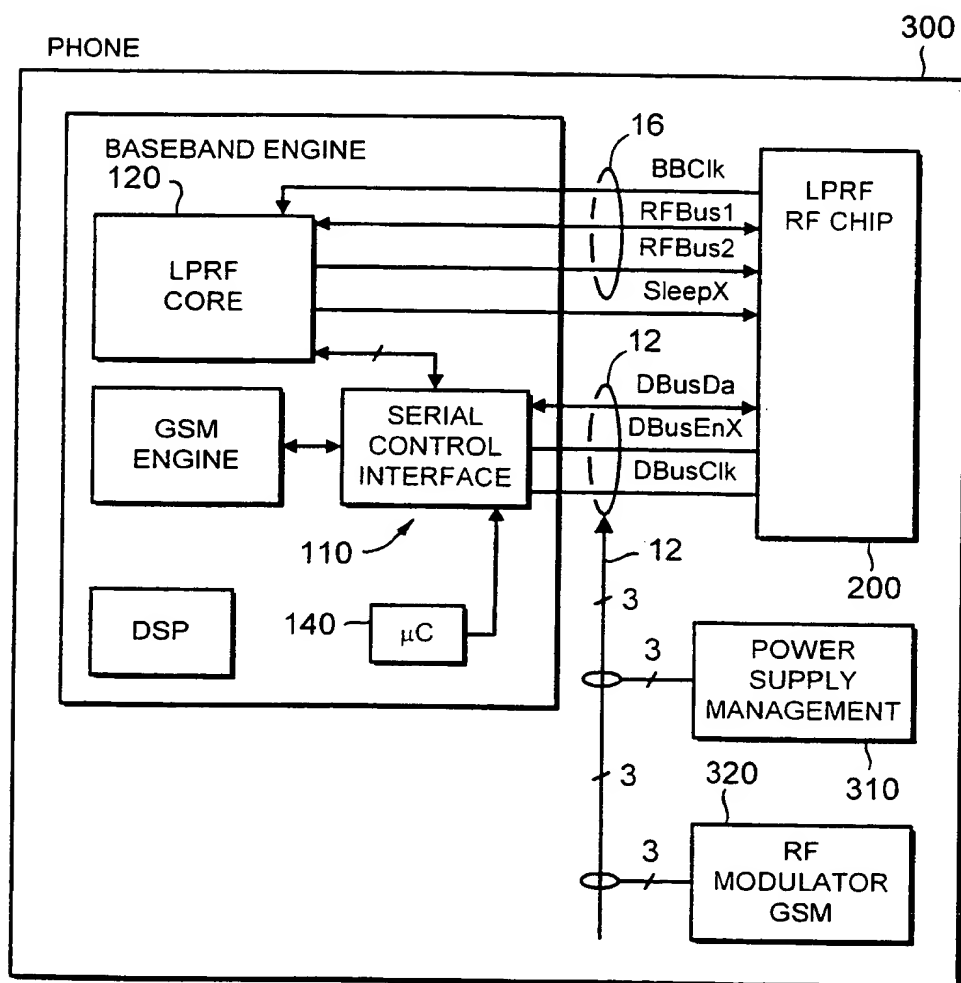


FIG. 3

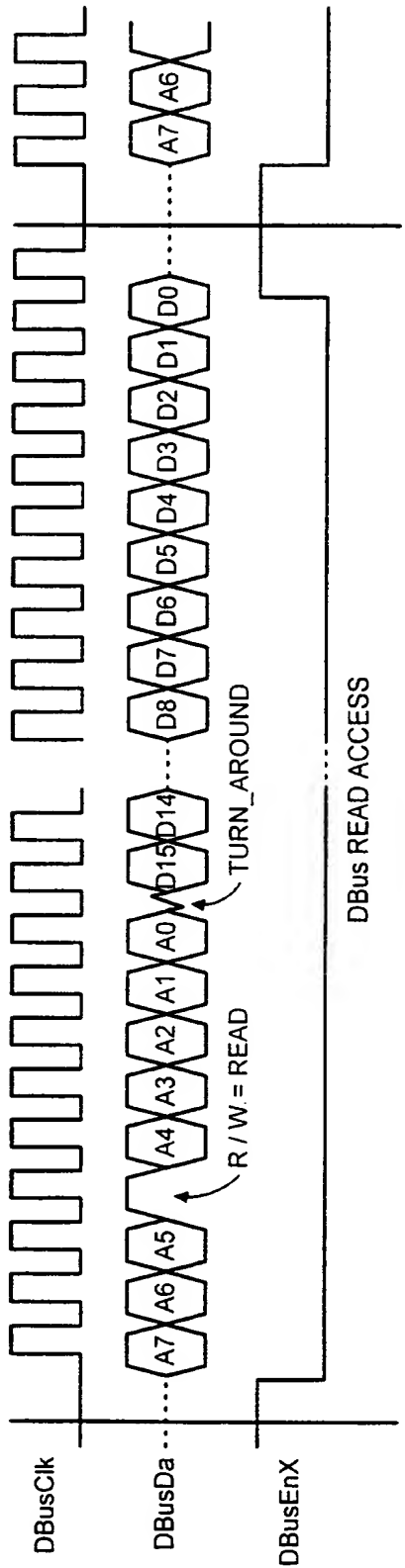


FIG. 4a

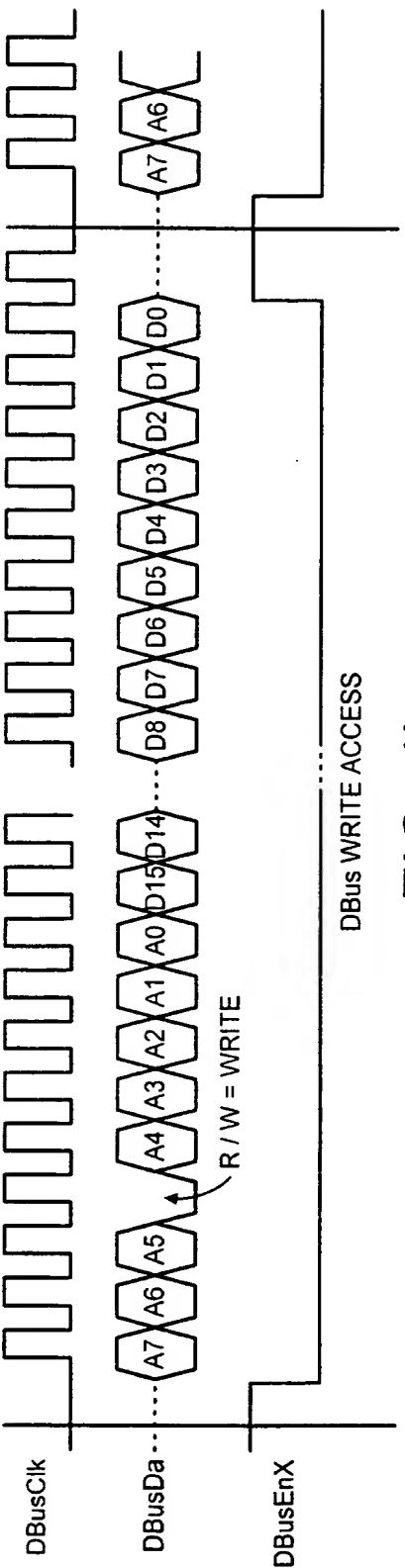


FIG. 4b

RECEIVED BY
AIR MAIL

130 JUL 2001

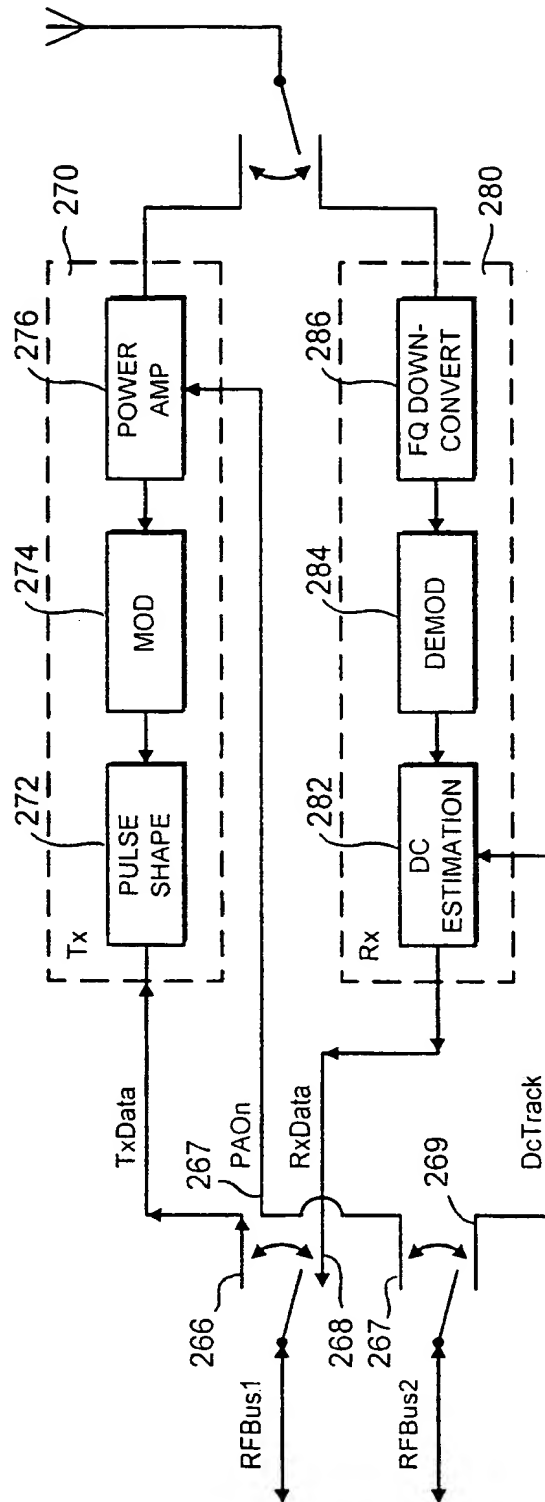


FIG. 1c

IN Tx Mode - SWITCHES UP
IN Rx Mode - SWITCHES DOWN